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(54) Balers

(57) A baler has a bale case (6) and a ram (4) for ramming material to be baled in discrete quantities into the case (6). A knotter (22) holds one end of a length of twine (8) to loop it about each bale as it is being formed. The twine (8) is progressively drawn by the bale from a supply (10) of twine as the bale being formed enlarges. The knotter (22) is responsive to an actuation signal for knotting the twine to complete the bale. A pulley (14) monitors the twine (8) as it is withdrawn from the supply (10) to produce the actuation signal each time a predetermined length of twine has been withdrawn.

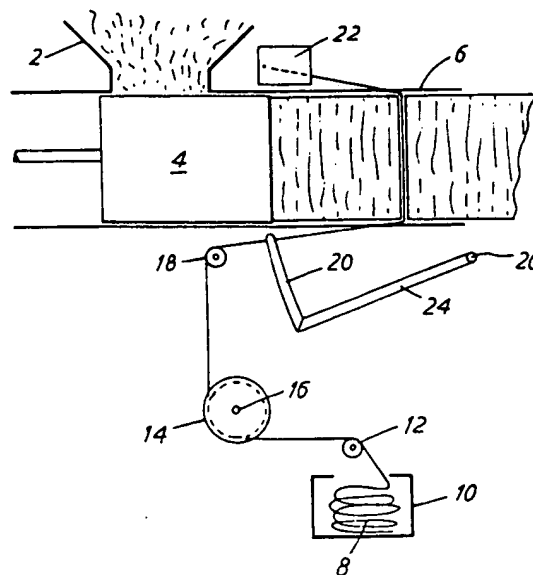


FIG. 1

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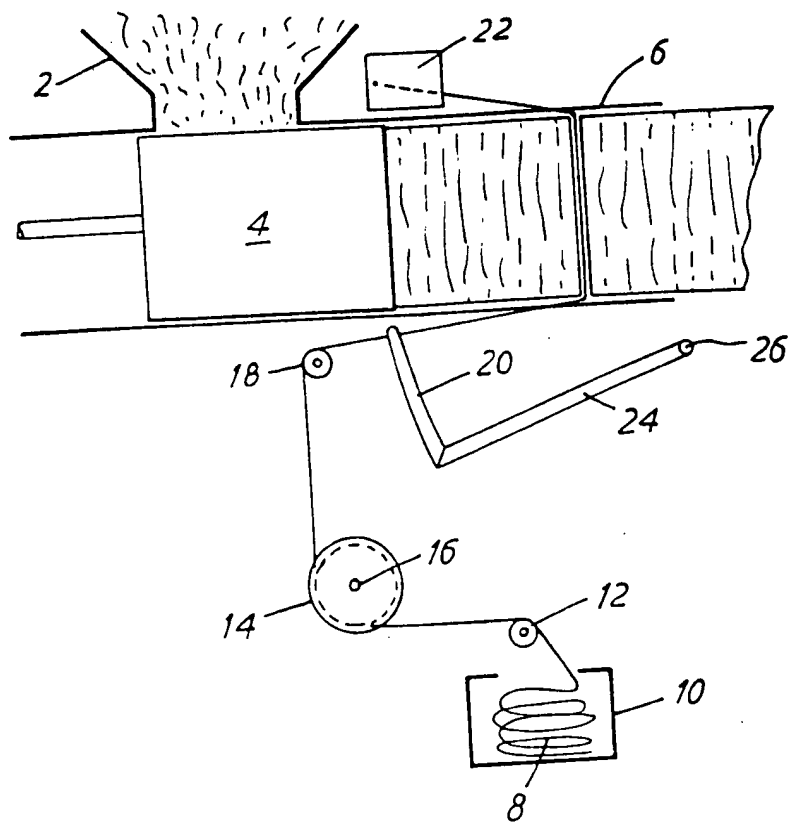


FIG. 1

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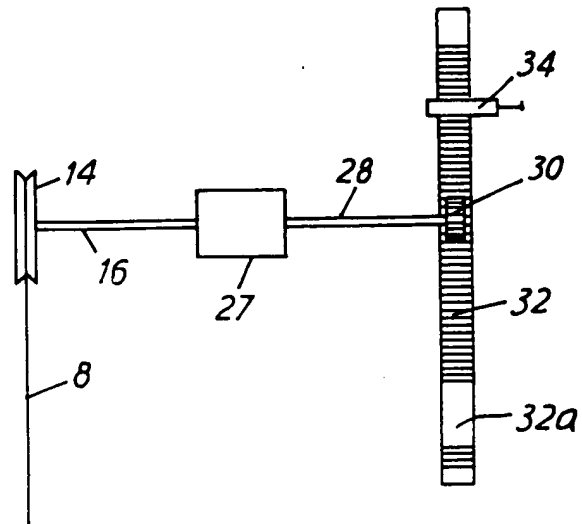


FIG. 2

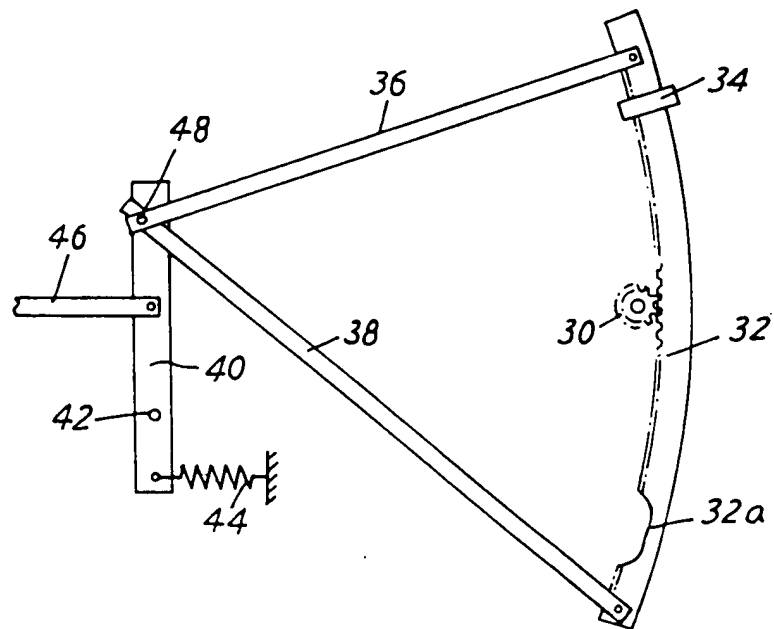


FIG. 3

SPECIFICATION

BALERS

5 The present invention relates to balers.

In previously proposed balers for producing straw bales, straw is rammed in discrete wads into a form or bale case until a required length of bale is achieved whereupon a binder and knoter completes a binding operation in which the bale is secured by two loops of twine.

As each bale is being formed its length is measured by a rotary toothed member which engages the upper face of the bale so that as the bale increases in length it causes the toothed member to rotate.

When the toothed member has rotated through a predetermined angle corresponding to the required length of the bale, the binder and knoter is actuated to complete the loop of twine about the bale and to knot it.

The arrangement suffers from the disadvantage that the bale length achieved is not uniform and can vary by up to 20%. Where the bales are subsequently stacked by mechanical means such variations in bale lengths may cause problems and can often result in the formation of unstable stacks or stacks which do not fit on to transporters in a compact manner for subsequent transportation.

It is an object of the invention to provide a baler which controls the length of resulting bales with greater uniformity.

According to the present invention there is provided a baler comprising a form, means for ramming material to be baled in discrete quantities into the form, means for looping twine about each bale as it is being formed, the twine being progressively drawn by the bale from a supply of twine as the bale being formed enlarges, means responsive to an actuation signal for knotting the twine to complete the bale and means for monitoring the twine as it is withdrawn from the supply to produce a said actuation signal each time a predetermined length of twine has been withdrawn.

A straw baler embodying the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a fragmentary side elevation of the baler;

Figure 2 is a side elevation of a bale length determining device; and

Figure 3 is a front elevation of the device of *Fig. 2*.

The straw baler shown in *Fig. 1* has a chamber 2 for receiving loose straw, a ram 4 for ramming discrete quantities of loose straw received from the hopper 4, into a form or bale case 6.

The baler is provided with two similar ar-

rangements for binding bales one adjacent each side of the bale, however for the sake of clarity, only one such arrangement is shown and described.

Twine 8 in a twine storage chamber 10 is fed around a first roller 12, a measuring pulley 14 mounted on a shaft 16, a second pulley 18, through the eye of a needle 20 and around the leading end of the bale currently being formed to a knoter 22. The knoter grips the free end of the twine 8.

The needle 20 is carried by an arm 24 supported on a pivot 26.

The shaft 16 is coupled to a reduction gear box 26 having an output shaft 28 carrying a pinion 30.

The pinion 30 engages an arcuate rack 32 (see also *Fig. 3*). An adjustable stop 34 is mounted in the rack 37. The rack 32 is pivotally supported at opposite ends by a pair of arms 36 and 38. The ends of the arms 36 and 38 remote from the rack 32 are pivotally secured by a common pivot 48 to a member 40.

The member 40 is pivotal about a pivot 42 and is biased in a counter-clockwise sense about the pivot 42 by a spring 44. This action causes the arms 32 and 38 to pull the rack 32 into engagement with the pinion 30.

An actuating arm 46 is carried by the member 40. The rack 32 has a deep recess 32a in a toothed section thereof.

In operation the ram 4 is reciprocated to compress and urge discrete quantities of straw into the form 6 against the bale 7 which has been previously formed. Twine 8 which has its free end held by a knoter 22 is engaged by the leading end portion of the bale as it starts to be formed and as the bale increases in length causes additional twine to be drawn from the storage chamber 10. The twine 8 as it is drawn rotates the pulley 16.

The surface of the pulley which is in contact with the twine is roughened to provide a greater coefficient of friction and so ensures that there is no slip between the twine 8 and the pulley 14.

As the pulley 14 rotates its rotation is communicated via the reduction gear box 26 and the output shaft 28 to the pinion 30. Rotation of the pinion 30 raises the rack 32. As rotation of the pinion 30 progresses it will eventually drop into the recess 32a and under the force of the spring 44 the member 40 will pivot in an anti-clockwise sense to displace the actuation arm 46. Displacement of the actuation arm 46 initiates a knotting operation. The knotting operation is delayed until the next return stroke of the ram 4 so as to clear a passage for the needle 20. Once the knotting operation has started the needle 20 is raised (by means not shown) to draw the twine 8 around the trailing end of the bale and to feed the twine 8 into the knoter 22 whereupon a knot is formed and the loop

about the bale completed. The twine 8 is cut and the new leading end of the twine is secured in readiness for receiving a new bale. At the end of the knotting operation the
 5 needle 20 is allowed to drop into its former position and the actuator arm 46 is displaced in the opposite sense against the force of the spring 44. This disengages the rack 32 from the pinion 30 which then falls under gravity
 10 until the stop 34 abuts the pinion. The actuator arm 46 is at this point released (by means not shown) and the rack 32 is brought back into engagement with the pinion 30 by the force of the spring 44. The baler is now ready
 15 to repeat the operation to form a fresh bale.

It will be appreciated that the setting of the stop 34 on the rack will determine the travel of the rack before a knotting operation is initiated and therefore the length of the bale
 20 formed.

It will also be appreciated that monitoring the length of twine which is drawn out as the bale is being formed enables the baler to form bales of a consistent length.

25 CLAIMS

1. A baler comprising a form, means for ramming material to be baled in discrete quantities into the form, means for looping
 30 twine about each bale as it is being formed, the twine being progressively drawn by the bale from a supply of twine as the bale being formed enlarges, means responsive to an actuation signal for knotting the twine to complete the bale and means for monitoring the
 35 twine as it is withdrawn from the supply to produce a said actuation signal each time a predetermined length of twine has been withdrawn.

2. A baler for baling loose material, the baler comprising a form, a ram for ramming loose material into the form to progressively produce a bale of said material from an outlet passage of said form, storage means for storing binding material, means for supporting a
 45 free end of the binding material drawn from the storage means and extended across said passage, whereby as said bale emerges from the passage, the binding material is drawn
 50 from the storage means to form a partial loop around the bale, means for monitoring the length of material drawn by the bale from the storage means, and control means responsive to the monitoring means having monitored a
 55 predetermined length to complete the loop and form a knot and thereby complete the binding of the bale.

3. A baler according to Claim 2, wherein the monitoring means comprises a pulley in
 60 contact with the binding material, the drawing of the binding material from the storage means effecting rotation of the pulley.

4. A baler according to Claim 3, wherein the monitoring means comprises a rack and
 65 pinion arrangement in which the rack is urged

towards the pinion, the pinion being drivingly coupled to the pulley and the rack having a stop and a section of missing teeth, the pinion engaging the stop at the start of each bale being formed and driving said rack in response to rotation of said pulley until the pinion engages the section of missing teeth whereupon the rack is displaced towards the pinion, this displacement indicating that said
 70 predetermined length has been drawn and triggering said control means to complete the binding of the bale.

5. A baler according to Claim 4, wherein said stop is adjustable whereby to vary the
 80 said predetermined length.

6. A baler according to Claim 4 or to Claim 5, wherein said rack is arcuate and pivotally supported at opposite ends by a pair of arms, the said arms being pivotally connected at ends remote from the rack to a common pivot carried by a pivotally supported lever, and including biasing means for biasing the lever about its pivotal point in a sense to urge the rack through the said arms into
 85 engagement with the pinion.

7. A baler substantially as hereinbefore described with reference to the accompanying drawings.

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